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Abstract

This paper investigates the macroeconomic implications of the rise in outstanding student debt in the United States using state-level data for the 2003–2019 period. We show that an increase in the state-level student debt-to-income ratio contributes to lower consumption growth in the medium run. The estimated effects are larger when we use an instrumental variable approach relying on exogenous policy changes including variations in state appropriations for higher education, increases in annual limits for subsidized federal student loans, and federal loan interest rate changes. The instrumental variable results show the hypothetical impact of an increase in student debt without an associated increase in educational attainment. We also find suggestive evidence that expansions in student loans lead to subsequent increases in credit card debt.

JEL Codes: E21, G51, I22

Keywords: Student loans, household credit, consumption, credit card debt

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1 Introduction

According to data from the New York Fed Consumer Credit Panel, outstanding student debt reached $1.5 trillion in 2019, representing the second largest type of household credit after mortgage debt. As such, student loans constitute a critical component of households' budgets, especially since repayment starts soon after the completion of schooling, when earnings are relatively low for many individuals. While the microeconomic literature has been uncovering statistically and economically significant relationships between student debt and households' finances, it is not clear whether the effects are evident at the macroeconomic level since a large share of borrowers do not appear to face much hardship in repaying their student debt (Baum and Schwartz, 2006). Previous macroeconomic studies focus on total household credit or on mortgage debt (Beck, Büyükkarabacak, Rioja, and Valev, 2012; Schularick and Taylor, 2012; Mian, Sufi, and Verner, 2017) and have not examined the effects of student loans.

This paper investigates the macroeconomic implications of the rise in outstanding student debt by studying the effect of student loans on subsequent consumption growth and changes in credit card debt. Two opposing channels determine the direction of the relationship: educational attainment and debt repayment effects of student debt on future consumption growth and credit card debt. The educational attainment channel allows individuals to invest in human capital, which generates a positive association between student debt and income (Avery and Turner, 2012), and thus subsequent consumption growth. Since credit limits on credit cards are tied to income levels, higher educational attainment can increase credit card borrowing through the credit supply channel. The debt repayment channel is driven by decreases in disposable income when borrowers are repaying their student loans. The magnitude of the debt repayment effects depends on whether student loan holders have

access to other credit markets during the repayment period. In perfect credit markets, non-student debt borrowing would increase to make up for the reduction in income, allowing unconstrained households to smooth consumption. If, however, credit markets are not perfect, some borrowers may lack access to other forms of credit and would be forced to lower consumption due to credit constraints. For these credit-constrained borrowers, supply of other types of loans will either not change or will decline if student debt impacts credit status (Brown and Caldwell, 2013; Mezza, Ringo, and Sommer, 2021). At the aggregate level, the combined responses of credit constrained and unconstrained households determine the magnitude and direction of the overall effect of student debt on subsequent consumption growth and changes in credit card debt.

Using state-level data for the 2003–2019 period, we study the effect of student loans on subsequent consumption growth and changes in credit card debt. We start by estimating the relationship between the growth in aggregate student debt and the growth in aggregate consumption by ordinary least squares (OLS) to test the combined effect of the two channels discussed above. Our OLS regression results show that student loans have a negative association with subsequent consumption growth. Our estimates suggest that a 1 percentage point increase in the change in student debt to income ratio is associated with a significant 0.7 percentage point decrease in the growth rate of consumption over the next three or four years. The magnitude of this result implies that the increase in student debt between 2012 and 2015, for example, is associated with 0.36 percentage points, or a 7 percent, decline in the growth rate of consumption between 2016 and 2019. These estimates suggest that the positive effect of an increase in income through higher educational attainment is not strong enough at the aggregate level to offset the decline in consumption growth that is due to the debt repayment channel.

To identify the magnitude of the debt repayment effects alone, we use an instrumental

variable (IV) approach using several instruments for student debt: federal and state-level legislation that led to exogenous changes in the supply of federal loans, loan interest rates, and funding for higher education. We also incorporate state-level measures of policy exposure for identification. This approach can tell us how a small change in student debt levels without an associated change in educational attainment, for example through a partial loan forgiveness program, would impact the economy. We find significant negative effects, considerably larger in magnitude than the OLS estimates, of student loans on consumption growth. One percentage point increase in the student debt to income ratio over the previous three years (slightly more than a standard deviation) is associated with a 1.6 percentage point (slightly less than half of a standard deviation) decline in consumption growth over the next three years. These results show that the debt repayment channel generates a large decline in subsequent consumption growth, suggesting that the response of credit constrained households is important in generating the link between student debt and consumption growth. The large negative effects also underline the importance of educational attainment in mitigating the effects generated by the debt repayment channel.

The relationship between student loans and subsequent changes in outstanding credit card debt helps us understand further the ways in which student loans affect borrowers' finances in the medium-run. The OLS results reveal a negative association between the two types of credit in the short run, which becomes weakly positive as we look at longer-run changes. This suggests that the combined effect of educational attainment and debt repayment results in slightly more credit card borrowing over the next four years. When we isolate the debt repayment channel using the IV approach, the effect remains positive and increases in magnitude, although the estimates are fairly noisy. These results provide suggestive evidence that households with access to credit cards increase their demand for borrowing to prevent a larger drop in consumption growth. Our findings also imply that the

decline in consumption growth would be larger for student debt holders who do not have access to other sources of borrowing.

Our research contributes to two main strands of the literature, one at the microeconomic, and one at the macroeconomic level. At the individual level, student loans have been found to affect household consumption and financial decisions following the completion of schooling. Previous research has shown student debt to be associated with delays in marriage (Gicheva, 2016; Sieg and Wang, 2018), decreases in homeownership rates (Bleemer, Brown, Lee, and van der Klaauw, 2014; Cooper and Wang, 2014; Gicheva and Thompson, 2015; Mezza, Ringo, Sherlund, and Sommer, 2020), increases in the likelihood of parental cohabitation (Bleemer et al., 2014; Dettling and Hsu, 2018), lower household net worth (Elliott and Nam, 2013), and overall financial distress (Elliott and Lewis, 2015; Gicheva and Thompson, 2015; Bricker and Thompson, 2016). Rothstein and Rouse (2011) show evidence that student debt affects borrowers' choices after graduation in a way that is consistent with binding credit constraints. A very recent paper by Mezza et al. (2021) emphasizes the importance of credit constraints when studying the link between student debt and different types of consumer borrowing at the household level. A key insight in their paper is that credit constrained households may be rationed from tightly underwritten credit markets, whereas unconstrained households maintain consumption smoothing by adjusting their borrowing.

Prior research has also uncovered important macroeconomic implications of household credit expansions, such as lower Gross Domestic Product (GDP) growth, higher unemployment, and financial instability (Büyükkarabacak and Valev, 2010; Beck et al., 2012; Schularick and Taylor, 2012; Mian et al., 2017). More recently, Bahadir and Valev (2020) show that the composition of household credit matters for the relationship between household credit growth and business cycles, emphasizing the distinction between consumer credit and housing loans. We complement these studies by examining student debt, a type of credit

that has not been studied in the context of aggregate macroeconomic fluctuations.

Our work is also related to the literature on understanding the effects of credit supply shocks on the overall economy. Mian et al. (2017), for example, focus on the role of credit supply shocks to explain the boom-bust cycles generated by household debt. They argue that increases in household debt are associated with low spreads, which supports the credit supply based explanations for the rise in household debt. In their more recent work, Mian, Sufi, and Verner (2019) study the banking system deregulation in the 1980s in the United States to identify credit supply shocks and show that credit supply expansions amplify the business cycle and lead to more severe recessions. Our paper contributes to this literature by examining the effects of increases in student loan limits and changes in interest rates, types of credit supply shocks, and using them to identify how student debt expansions affect aggregate consumption growth in the medium-run.

Our finding on the link between student debt and subsequent consumption growth is informative of the degree to which student loans can affect non-borrowers through their impact on macroeconomic conditions. Even if borrowers are not defaulting on their student debt, the decline in their consumption has widespread implications for the overall economy. Lower consumption growth leads to slack in aggregate demand and affects employment and overall economic growth. Finding evidence of such spillover effects of student debt on non-borrowers emphasizes the importance of policies aimed to reduce excessive student debt. Student loan forgiveness and cancellation programs, for example, may mitigate the negative macroeconomic consequences of student debt. Policymakers should also identify the factors that contribute to the build-up of excessive borrowing for education and evaluate the effectiveness of policies, such as slowing the growth rate of tuition and providing more need-based grants, which may lower the demand for student loans without affecting educational attainment.

2 Macroeconomic Significance of Student Debt

Studies of the macroeconomic effects of household debt do not separate student loans from other types of credit, even though recent trends in the data underline the importance of studying student loans separately from mortgages and other types of consumer credit. As Figure 1 shows, outstanding student debt more than tripled between 2003 and 2019, while other household debt saw an overall decline, mostly due to negative growth after the Great Recession. The number of borrowers doubled and the aggregate inflation-adjusted amount of student debt more than tripled between 2000 and 2014 (Looney and Yannelis, 2015), making student debt the second largest type of household credit after mortgage debt. As a result, student loans have become an increasingly important component of household credit with potentially unique consequences for consumption dynamics.

There are several other important reasons why we need to understand the macroeconomic effects of student debt separately from those of other household credit. Unlike mortgages, student loans do not finance any type of tangible asset. Buying a house and owning a mortgage allows households to build equity while covering an important living expense. In case of economic hardship, a homeowner can sell the house to pay off the mortgage and use equity to generate liquidity. Student loans are not backed by any tangible asset and cannot help borrowers build equity. Therefore, when student debt holders have financial difficulties, they do not have a buffer to use in the way mortgage holders have, and consumption is more likely to be affected.

The uncertainty associated with educational and labor market outcomes creates risks associated with student borrowing. Only slightly more than half of incoming postsecondary students who say they expect to earn a four-year degree do so within six years, and over half of the noncompleters accumulate student debt (Avery and Turner, 2012). In 2016, 25% of

student debt was held by households in which neither the head nor spouse had a four-year college degree (Baum and Looney, 2020). There is substantial variation in realized earnings for individuals who hold similar amounts of student debt (Looney and Yannelis, 2015). This suggests that many borrowers accumulate student debt without collateral or equity. These financial risks, combined with stringent requirements for discharging student debt, create unique challenges for student debt holders.

Another important factor regarding student loans is that this type of debt is disproportionately held by younger borrowers. According to calculations based on data from the New York Fed Consumer Credit Panel, borrowers age 18–29 held $370 billion in student debt in 2016; those age 30–39 held $454 billion; and older borrowers' balances amounted to $534 billion. As a comparison based on the same data, borrowers in the youngest age group held 4% of outstanding mortgage debt.[1] Younger borrowers tend to have consumption patterns that are highly sensitive to temporary changes in liquidity (Gross and Souleles, 2002). While there is generally a positive correlation between student debt holdings and income, 47 percent of borrowers entering repayment in 2011 came from for-profit or two-year institutions, and unemployment rates for these borrowers tend to be high while earnings tend to be low (Looney and Yannelis, 2015). Furthermore, federal student loan borrowers do not undergo a credit check process and could have poor financial health at the time of loan origination, unlike other household debt holders who are required to have a relatively strong credit history and to have funds for a down payment when buying a house.

These household characteristics play an important role in understanding the debt repayment channel discussed above. Student debt holders are young, financially less secure, and face uncertainties regarding labor market outcomes. As a result, many encounter credit constraints (Mezza et al., 2021). For these households, consumption smoothing may be difficult

[1] See www.newyorkfed.org/microeconomics/databank.html.

to achieve and pronounced responses to changes in income and credit market conditions are likely. If repayment schedules force credit-constrained borrowers to pay off student debt when earnings are relatively low, this process will result in lower consumption, affecting the rest of the economy through changes in aggregate demand. Unconstrained households, on the other hand, have access to other forms of borrowing such as credit cards, and are expected to adjust their borrowing to prevent declines in consumption. When paying off student debt, they may increase their demand for credit, leading to a positive association between student loans and subsequent changes in credit card debt. As a result, the debt repayment effect of student debt on subsequent consumption growth and changes in credit card debt depends on the combined responses of constrained and unconstrained households, warranting an empirical analysis.

In the next section, we discuss our empirical approach for examining the link between student debt and subsequent growth in consumption and credit card debt. We also provide details about the instrumental variables we use to isolate the direct causal effect of student debt.

3 Empirical Methodology and Data

The general model we are interested in estimating for state i in year t is:

$$\Delta_s y_{it+s} = \alpha_i + \beta[\Delta_s StudentDebt/Income_{it-1}] + \gamma \cdot [\Delta_s X_{it-1}] + \nu[\Delta_s y_{it-1}] + \eta_t + \varepsilon_{it}, \quad (1)$$

where $\Delta_s z_\tau$ stands for the change in the variable z from year $\tau - s$ to τ.[2] In this model, y denotes the outcome of interest, which is the natural log of per-capita consumption ex-

[2]It should be noted that specifications that model changes in consumption between t and $t+s$ as a function of changes in student debt between $t-s-1$ and $t-1$ are in line with the timing of data collection because household debt refers to the fourth quarter of the year but consumption is measured over the whole year.

penditure (from the U. S. Bureau of Economic Analysis' Personal Income and Outlays report) or outstanding credit card debt (from the New York Federal Reserve Bank's Consumer Credit Panel, which is constructed from a random sample of Equifax credit reports). $StudentDebt/Income$ measures the ratio of per-capita outstanding student debt to personal income and includes both federal and private loans; data come from the Consumer Credit Panel and the Bureau of Economic Analysis. X is a vector of time-varying controls at the state level including other types of household credit (Consumer Credit Panel), the state unemployment rate (U.S. Bureau of Labor Statistics/Current Population Survey), the shares of the state's population with a completed four-year degree and with some college education but less than a Bachelor's degree (American Community Survey), and enrollment in public four-year institutions in the state (National Center for Education Statistics, Integrated Postsecondary Education Data System). The model further includes a state fixed effect α_i and a year fixed effect η_t; ε is an error term.

The specification includes a lagged change in the dependent variable to account for potential mean reversion dynamics associated with the standard business cycles; this approach is similar to the one used in previous studies such as Bahadir and Valev (2020).[3] The lag in the dependent variable, which has the same timing as the student debt-to-income ratio, also controls for macroeconomic conditions at the time of debt accumulation, so our estimates are more likely to represent a causal effect of student debt on future economic outcomes. We allow for clustering of the errors at the state level. We report standard errors based on Driscoll and Kraay (1998) in the online appendix; they are similar or often smaller than the errors that allow clustering at the state level. We use the number of individuals included in the Consumer Credit Panel as estimation weights, so that larger states are given more weight and our estimates are more representative of the U.S. population. We use the July

[3]Results without lags in the dependent variable are shown in the online appendix to the paper.

Consumer Price Index for each year to convert dollar amounts to 2018 dollars for data series that are not inflation-adjusted.

The model in (1) includes separate controls for other categories of household credit because each type of credit is expected to have a different relationship with the outcomes of interest and with student debt. One relevant factor is whether the loans finance durable physical assets, such as a houses or a cars, or nondurable nontangible consumption, such as a vacation. Furthermore, as documented in Mezza et al. (2021), how tightly a credit market is underwritten matters for the distribution of credit among constrained and unconstrained households. Decomposing household debt into its sub-categories provides relevant information and helps us improve the precision and accuracy of our models.

The timing of the relationship between student debt growth and economic outcomes is important since an exogenous increase in borrowing is expected to boost aggregate demand and hence have an immediate positive effect on output. Possible negative effects are expected to occur when borrowers start to service their debt. We estimate version of equation (1) with s varying between 1 and 4, but our preferred specification is the one with $s = 3$ because it captures well the medium-run effects. Existing studies on the link between credit expansions and macroeconomic fluctuations use similar lag structures to capture the medium-run effects of debt on business cycle dynamics, capturing the eventual negative effects of debt that arise after an initial expansion in consumption.[4] We expect the short-run relationship between student debt and aggregate consumption to be less negative or possibly positive because student loans can be used to finance consumption, thus also acting as substitute for credit card debt.[5] The lag structure with $s = 3$ further aligns with the time it takes for a typical

[4]See Mian et al. (2017) for more discussion on short vs. medium-run dynamics generated by household debt.

[5]As Cadena and Keys (2013) discuss, it is common for students living off-campus to receive part of their financial aid in the form of a refund check, which they can use to pay for living expenses. Subsidized federal loans, which have zero interest rate while an individual is enrolled in school, shift the student's budget set up and are expected to result in higher consumption levels.

student to finish college and start paying off the debt.

Estimating equation (1) by OLS can inform us about the relationship between student debt and subsequent changes in aggregate consumption without accounting for educational attainment beyond the basic controls included in the model. Increased educational attainment is expected to generate a positive association between student debt and consumption, in contrast to any negative effects driven by household credit constraints. The OLS results tell us about the overall macroeconomic implications of student debt. If instead the counterfactual we are interested in is the macroeconomic effect of a marginal increase in student debt without a corresponding increase in educational attainment, we need sources of exogenous variation in student borrowing. The following section discusses how we approach this issue.

3.1 Instrumental Variable Estimation

Recognizing that student debt is correlated with multiple factors that can prevent researchers from identifying direct causal effects on household financial well-being, recent microeconomic studies have relied on plausibly exogenous policy-induced variations in student borrowing. Gicheva and Thompson (2015) use cross-cohort variations in the average amount of incurred debt. Joensen and Mattana (2017) estimate a dynamic discrete choice model of education, employment, and student borrowing and use the 2001 Swedish Study Aid reform for identification. Gervais and Ziebarth (2019) exploit nonlinearities in the eligibility formula for federal subsidized loans, while Mezza et al. (2020) use changes in in-state tuition rates as an instrument.

Using data aggregated at the state level means that our sample covers a longer time period compared to many microeconomic studies, and our empirical strategy relies on three types of policy changes, each of which generates variations in student debt levels during a

different portion of the sample period. Having three instrumental variables helps us identify changes in student debt over the full period. We next describe each of the instruments.

3.1.1 Stafford Loan Limits

The first two instruments we rely on are based on changes in the federal Stafford loan program and represent credit supply shocks. Federal Direct Stafford Loans are relatively low-interest loans to students at Title IV eligible institutions, which are all postsecondary institutions in the U.S., including for-profits, whose students can receive federal financial aid. Subsidized Stafford loans are need-based; interest payments on these loans are subsidized by the federal government while borrowers are attending school and up to six months after. Unsubsidized loans are not need-based, and students start owing interest as soon as the loan is issued, but the interest can be capitalized, deferring payments until after graduation. During the 2018–19 academic year, over 5 million undergraduate students took out a subsidized Stafford loan, for a total balance exceeding $20 billion, or 19% of all federal and non-federal loans disbursed that year;[6] unsubsidized Stafford loans were distributed to 6.5 million undergraduate and graduate students with a total balance of $49 billion (Baum, Ma, Pender, and Libassi, 2019).

For our first instrument, we use changes in the availability of subsidized Stafford loans. This approach is most similar to the one in Lucca, Nadauld, and Shen (2018), who rely on changes in subsidized and unsubsidized Stafford limits and Pell grant limits to study how postsecondary institutions change their prices in response to changes in student loan availability. Panel A of Table 1 summarizes the three main pieces of legislation that changed the limits for subsidized and unsubsidized Stafford loans since the Higher Education Amendments of 1992, while Figure 2 shows inflation-adjusted total annual loan disbursements for subsidized Stafford, unsubsidized Stafford and other student loans including those from state

[6] As noted in Table 1, graduate students were not eligible for subsidized loans in 2018–19.

and private sources based on data from Baum et al. (2019) for the period covering the 1995–96 to 2018–19 academic years.

The Higher Education Reconciliation Act of 2005 (HERA) increased the limit for subsidized Stafford loans from $2,625 to $3,500 for freshmen and from $3,500 to $4,500 for sophomores starting with the 2007–2008 academic year; the annual limit for additional unsubsidized Stafford loans increased by $2,000 for graduate students. Starting in the following year, the Ensuring Continued Access to Student Loans Act of 2008 increased unsubsidized Stafford loan limits for most students. Figure 2 shows corresponding sharp increases in subsidized and unsubsidized Stafford borrowing and a corresponding decrease in the amount of other types of loans; overall loan originations went up. Lucca et al. (2018) and Baum et al. (2019) further document pronounced increases in student borrowing following the HERA. We consider the 2007–2008 and 2008–2009 policy changes jointly. Since debt and consumption are measured over calendar years, we consider this policy to be active starting in January 2008.[7] Thus, for our analysis we use the policy change indicator $\Delta_3 HERA_{t-1}$, which is equal to 1 in 2009, 2010, and 2011 and to 0 in all other years.[8]

Figure 2 also shows that subsidized Stafford borrowing declined sharply with the Budget Control Act of 2011, which made these loans unavailable to graduate and professional students. Much of the decrease was offset by increases in all other types of loans, and as a result this policy change has considerably lower predictive power over aggregate student debt holdings and is not used as an instrument in our analysis.

[7] In general, we address the discrepancy between academic and calendar years by matching academic years to the later calendar year. This reflects the fact that policy changes implemented in July of a given year likely take some time to affect variables measured over calendar years.

[8] Figure A1 in the Appendix shows the average values and 95% confidence intervals for each of the instruments over time.

3.1.2 Stafford Loan Interest Rates

The second instrument we use exploits variations in the interest rate for federal Stafford loans. Panel B of Table 1 summarizes the relevant policy changes. We focus on interest rates applicable to undergraduate students while the loan is in repayment; rates for graduate students and during in-school and grace periods differ in some years, but exhibit similar trends over time. We use the rates for unsubsidized Stafford loans; since these loans are not need-based, it is plausible that students' borrowing decisions are more sensitive to the interest rate. In many years, the rates for subsidized and unsubsidized loans are the same.

Prior to the 2006–2007 academic year, the interest rate for both subsidized and unsubsidized Stafford loans equaled the 91-day Treasury Bill rate as of June 1 of that year plus 2.3 percentage points. Rates were variable during this period, meaning that the rate for a given loan changed each year during its lifetime. Starting in July of 2006, rates became fixed for the duration of the loan and were set to equal 6.8%. Subsidized loan rates decreased starting with the 2008–2009 academic year. As of July 2013, the interest rates were set to equal the 10-year Treasury Bill rate plus 2.05 percentage points.

The variable we construct, $\Delta_3 Spread_{t-1}$, is based on three-year changes in the interest rate spread between unsubsidized Stafford loans and the 91-day Treasury Bill rate as of June 1 of the given year.[9] Figure 3 shows how the unsubsidized Stafford interest rate and the spread change over time. As the spread increases, we expect students to rely less on student loans to finance their expenses during college. As Figure 3 reveals and Figure A1 in the Appendix also shows, there are fairly large changes in the interest rate spread in certain years during the sample period, but the change from year $t-4$ to year $t-1$ is zero or close

[9]The literature on business cycles and credit expansions uses interest rate spreads as an instrument for credit supply shocks. See, for example, Gertler and Karadi (2015) and Mian et al. (2017). We use the 91-day Treasury Bill rate for two main reasons: because federal loan rates were explicitly tied to it during some periods, and because it captures well variations in the rates for substitute sources of household credit, such as credit cards (see Figure 3 in the online appendix).

to zero in 2007–2009 and 2014.

3.1.3 Exposure Measures

The changes in borrowing limits and interest rates took place at the federal level, so we cannot use them alone to identify cross-state variations in outstanding student debt. We construct time-invariant measures of state-level exposure to the policy changes, which should predict the strength of the state-level responses in the per-capita ratio of student loans to personal income. Specifically, we use data from the 1999–2000 National Postsecondary Student Aid Study (NPSAS) to calculate the share of undergraduate students in each state who borrowed the maximum subsidized Stafford amount during that academic year ($ExposureSubs$) and the share of all students (graduate and undergraduate) who borrowed the maximum total (subsidized and unsubsidized) Stafford amount they were eligible for ($ExposureAll$). The timing of these measures is chosen so that it precedes our sample period and should therefore be unaffected by variables in the models.

Figure 4 shows the values of the exposure measures for each state. The shares of students borrowing at the subsidized and unsubsidized maximums are highly correlated, but there exists substantial variation across states. The share of undergraduate students who borrow at the subsidized limit ranges from 3.9% in Delaware to 43.7% in South Dakota, with 25^{th} and 75^{th} percentiles equal to 9.1% and 16.5%, respectively, and a median of 12.0%.

We interact the share of undergraduate students borrowing the maximum subsidized Stafford with the change in subsidized Stafford limits described in Section 3.1.1. The share of all students borrowing the maximum total Stafford amount is interacted with the change in the interest rate spread discussed in Section 3.1.2.

3.1.4 Educational Appropriations

The third instrument we use is derived from state-level data on educational appropriations per full-time-equivalent (FTE) student. These data come from the State Higher Education Finance report published by the State Higher Education Executive Officers Association. We expect educational appropriations to be relevant for student debt because of their direct impact on the cost of higher education through tuition levels and financial aid awarded at public institutions. Prior studies such as Goodman and Volz (2020) have established a negative relationship between state funding for education and student debt levels. The instrument we use measures the percent change in appropriations per FTE student between years $t-4$ and $t-1$: $(\Delta_3 Appropr_{t-1})/Appropr_{t-4}$.

Figure 5 shows that there exists substantial variability in educational appropriations per student across states, and there is also variation over time during the sample period. This can also be seen in Figure A1 in the appendix. The 90^{th} percentile of the distribution (measured in 2018 dollars) varies between \$9,300 in 2013 and \$12,600 in 2019; the median is between \$6,200 in 2012 and \$8,600 in 2008; and the 10^{th} percentile takes on values between \$4,600 in 2012 and \$6,400 in 2008.

In summary, we focus on on specification with 3-year lags and estimate jointly the following first-stage equation in combination with the second-stage model in (1) when $s = 3$:

$$\begin{aligned} \Delta_3 StudentDebt/Income_{it-1} = a_i &+ b_1[\Delta_3 HERA_{t-1} \times ExposureSubs_i] \\ &+ b_2[\Delta_3 Spread_{t-1} \times ExposureAll_i] \\ &+ b_3[(\Delta_3 Appropr_{it-1})/Appropr_{it-4}] \\ &+ c_1 \cdot [\Delta_3 X_{it-1}] + c_2 \Delta_3 y_{it-1} + d_t + u_{it}. \end{aligned} \tag{2}$$

We show results both from a two-stage least squares estimator and a limited information

maximum likelihood estimator, which can have better properties especially under weak instruments. is Table A1 in the Appendix shows descriptive statistics for the variables used in the analysis.

3.1.5 Validity of the Instruments

For the first two instruments in Equation (2) to be exogenous, the share of students borrowing at the limit in 1999–2000 needs to be uncorrelated with changes in consumption growth and other macroeconomic variables during the 2003–2019 period, aside from a potential effect through student debt. Figure 4 shows that states with high and low levels of the exposure measures vary in size and region, which can also be seen in Figure 1 in the online appendix. While several high-exposure states (those in the top quartile of the distribution) are located in the Midwest, a state in the Pacific Northwest (Oregon) and several states in the Northeast also appear in this group. Low-exposure states (those in the bottom quartile of the distribution) can be found in all regions of the country.

Table 2 shows the degree to which the share of students in each state borrowing at the subsidized and total Stafford limits is correlated with aggregate education measures and state-level macroeconomic indicators. We estimate a regression of each exposure measure on enrollment-weighted average tuition at four-year institutions, the natural log of educational appropriations per FTE student, and the share of postsecondary students enrolled in public institutions during the 1999–2000 academic year.[10] In separate regressions, we estimate the relationship between the share of students borrowing at the limit and one-year changes in the unemployment rate and the natural log of consumption at three points in time: concurrently with the exposure measures; toward the beginning of our sample period; and toward the end of the sample period.

[10]Data on tuition and enrollment are from the Integrated Postsecondary Education Data System (IPEDS) collected by the U.S. Department of Education's National Center for Education Statistics.

The regression results in columns (1) and (5) of Table 2 show that much of the variation in the exposure measures is explained by cross-state variations in public tuition charges, state educational appropriations, and the supply of seats at public institutions. Columns (2) – (4) and (6) – (8) show that there is not much contemporaneous correlation between the exposure measures and one-year changes in consumption and unemployment. These variables explain almost none of the variation in the share of credit-constrained students, and their coefficients are not statistically significant. These results are suggestive that the fraction of credit-constrained students is driven by state-level education policies, but is not correlated with the macroeconomic outcomes we consider in the main analysis.

Exogeneity of the appropriations instrument requires that changes in state funding for education do not predict subsequent changes in aggregate consumption. Table 3 examines the relationship between the percent change in appropriations between $t-4$ and $t-1$ and change in log consumption between t and $t+3$, with and without other controls from the main specifications. State funding for education is in part driven by economic conditions (Goodman and Volz, 2020), which may lead to positive correlation between changes in appropriations and contemporaneous changes in consumption. However, Table 3 shows that the relationship between education funding and consumption in later periods is not statistically significant.

It is possible that the supply of federal loans and state funding for education impact aggregate consumption through their potential effects on educational attainment (e.g. Black, Denning, Dettling, Goodman, and Turner, 2020; Goodman and Volz, 2020). If this is the case, our IV model would likely underestimate the strength of the repayment channel driving the relationship between student debt and consumption because we would not account for the full increase in educational attainment associated with an increase in student debt. We report results from overidentification tests of the instruments; in the specifications model-

ing consumption, we cannot reject the null hypothesis that the instruments should not be included in the second-stage model in (1).

It is also necessary that the instruments have good predictive power over the endogenous variable. As discussed above, each of the instruments identifies changes in student debt over a different time period, with the strongest identification coming from the middle of the sample period. Appendix Figure A2 shows a comparison of the predicted and actual values of the endogenous variable from a model that includes only the three instruments and state fixed effects. The plot suggests that we capture time variations in aggregate student debt well, particularly in the middle of the distribution and the middle of the sample period.

We next present our estimation results based on the models and data described in this section and offer a discussion of their economic significance.

4 Results

The relationship between student debt and consumption is first examined in Table 4, which shows OLS estimation results for the model in equation (1) with lags ranging between 1 and 4 periods.[11] The results suggest that the relationship between student debt and consumption starts off positive and significant, decreases to about zero in the specification with two-year lags, and becomes negative when we consider longer lags. This slow response of consumption to changes in credit is also found in the related literature, for example Mian et al. (2017). The short-term relationship between student debt and consumption can be driven by students using loans to finance consumption (Cadena and Keys, 2013), and the fact that subsidized federal loans are interest-free while the borrower is enrolled in school up to six months after completion of schooling. For example, Cadena and Keys (2013) calculate that an undergraduate student borrowing the maximum subsidized amount each year receives a

[11] The complete set of coefficient estimates is shown in the online appendix.

$1,500 total subsidy from the government, assuming an interest rate of 4%.

The estimates reported in Columns (3) and (4) suggests that a 1 percentage point increase in the change in student debt to income ratio is associated with a significant 0.7 percentage point decrease in the growth rate of consumption over the next three or four years. As discussed earlier, these estimates combine the two competing mechanisms of higher educational attainment on the one hand and inability to smooth consumption due to credit constraints on the other. To understand the magnitude of the coefficients better, consider that student loan debt per capita increased from $4,000 in 2012 to $4,460 in 2015. Adjusted for the change in income during the same time period, this represents a 0.54 percentage point increase, which our estimates suggest corresponds to an aggregate consumption growth decrease of 0.36 percentage points between 2016 and 2019, or about 7% of the actual observed growth in consumption during this period.

The negative relationship between student debt and consumption is consistent with existing studies on household debt and business cycles. For example, in Bahadir and Valev (2020), a 1 percentage point increase in household debt results in a 0.52 percentage point lower consumption growth, and in Mian et al. (2017) the same change in household debt leads to a 0.37 percentage point decline in output growth.

While not the focus of this paper, the coefficient estimates for other types of debt reveal that different types of household credit have differential relationships with consumption growth. We find that an increase in mortgage and other debt is associated with negative subsequent consumption growth, whereas auto loans and credit card debt have a positive relationship in some of the specifications. These results imply that each type of household credit has distinct features and may lead to different consumption dynamics. One possibly important debt characteristic is the type of expense the loan finances. Whether households borrow to purchase a durable physical asset or they use loans to pay for non-durable goods

or services may determine the direction of the relationship between household debt and consumption. Another important factor is the type of household that has access to each type of loan. As documented in Mezza et al. (2021), tight underwriting rules may ration some borrowers and determine the distribution of debt among credit constrained and unconstrained households. When paying off debt, credit constrained households are expected to lower their consumption whereas unconstrained households are able to achieve a smooth pattern in consumption.

One type of debt that has a large negative association with subsequent consumption growth is the "other debt" category, which includes personal loans and retail credit. Mezza et al. (2021) argue that good-secured loans and installment sales contracts are more easily accessible forms of borrowing, as they are not as tightly underwritten as some other forms of credit, such as credit cards. As a result, credit-constrained households may be likely to use these loans to finance current consumption and may be forced to lower future consumption when paying them off.[12] While this is a plausible mechanism, identifying the exact channels through which these types of loans affect consumption growth requires a separate empirical analysis, which we leave for future research.

The IV estimation results in Table 5 show the effects of student debt on aggregate consumption, holding educational attainment constant. We focus on the specification with three-year lags and present two sets of results, with and without a control for lagged consumption growth. Columns (1) and (4) show the first-stage estimation results, along with F-statistics and overidentification test statistics for the excluded instruments. The two-stage least square estimates in columns (2) and (5) are very similar to the LIML estimates in columns (3) and (6). The coefficient estimate on the student debt to income ratio sug-

[12]The fact that we find mostly positive association between medium-run consumption growth and credit card debt is in line with this argument if the latter is more tightly underwritten than many types of personal loans.

gests that a 1 percentage point increase in student debt leads to a 1.6 percentage point (1.5 percentage point in the model without lagged consumption growth) lower consumption growth during the subsequent three years. The fact that the IV estimates are more negative than the OLS estimates confirms the potential positive effect of educational attainment on consumption.

To put the estimate in context, we can consider the recent announcement by the U.S. Department of Education that it will cancel $1.1 billion of student debt for borrowers who attended a now defunct chain of for-profit institutions (Marnin, 2021). This decrease in student debt, not associated with a decrease in educational attainment, represents a change of about 0.005 percentage points in the student loan-to-income ratio for the U.S., which our IV estimate suggest would increase annual aggregate consumption growth by 0.003 percentage points. A hypothetical large loan forgiveness program, for example one that cancels $10,000 of student debt per borrower, would reduce the student debt to income ratio by about 2 percentage points given that there are currently 45.4 million federal student loan holders (Ma and Pender, 2021), resulting in over 1 percentage point higher annual consumption growth, a sizable increase. As another thought experiment that can help compare the magnitudes of the OLS and IV results, suppose that student debt increased by the same amount between 2012 and 2015 but without a corresponding increase in educational attainment. Then the associated decrease in consumption growth between 2016 and 2019 would have been 0.9 percentage points, or much higher than the OLS estimates suggest because those estimates incorporate the increase in consumption due to the income increase associated with schooling.

The first-stage results reported in Columns (1) and (4) show that the coefficients on the instruments have the expected signs. The increase in borrowing limits associated with the Higher Education Reconciliation Act of 2005 interacted with the state-specific share of undergraduate students borrowing the maximum Stafford has a positive and significant effect

on the change in student debt to income ratio, while the interest rate spread interacted with the corresponding exposure measure is negatively related to student borrowing. As student loans become more expensive, individuals accumulate less of them. Higher educational appropriations have negative impact on student debt. The instruments have good predictive power over aggregate student debt: the F-statistic for the test of the hypothesis that the instruments are unrelated to the endogenous variable is close to 21, indicating that weak instruments should not be of concern here.[13]

Tables 6 and 7 present, respectively, the OLS and IV estimation results with credit card debt as the outcome variable. Higher educational attainment increases disposable income, which should lead to higher limits on credit cards but also decrease the demand for borrowing. The debt repayment channel is expected to generate a positive relationship between student loans and credit card debt, as credit cards allow households to smooth out consumption when paying off student debt for households that are not credit-constrained (Mezza et al., 2021).

Our OLS results show that there is a negative relationship between the two debt types of credit in the short-run, which suggests that they may be substitutes. The estimated correlations increase as we consider longer lags and borrowers enter the debt repayment phase. With four-year lags, we find a positive and weakly significant correlation between student debt and credit card debt.

When the debt repayment channel is isolated through the IV approach, we find a larger positive medium-run effect of changes in student debt on future credit card debt, with LIML estimates significant at the 10% level. A 1-percentage point increase in the student loan-to-income ratio over a three-year period leads to a 0.32-0.43 percentage point increase in the credit card-to-income ratio over the following three years. This result provides suggestive

[13]We report F-statistics that account for the fact that we estimate cluster-robust standard errors.

evidence that borrowers who have access to credit cards increase their demand for borrowing to finance their spending when paying off student debt. If credit card debt were not available to them, as in the case for constrained households, the negative effects of student loans on consumption could be even larger, but estimating the extent to which this is the case is beyond the scope of this paper.

The magnitude of the estimated effect of student debt on credit card debt is also large, but similarly to the effect on consumption, it represents the hypothetical scenario of an increase in student debt without an associated increase in educational attainment. Furthermore, credit card interest rates tend to be substantially higher than interest rates on student loans, so households using credit cards to finance consumption and rolling over their credit card balances during student loan repayment periods can experience faster growth in credit card debt compared to the corresponding decrease in student loan debt. Holding student debt may also restrict borrowers' access to more favorable loan markets (Brown and Caldwell, 2013), resulting in further increases in their credit card debt. There could be additional spillover effects of student debt, where the income and credit card debt of individuals without student loans is affected by the decrease in aggregate consumption caused by student loan debt. We also observe a strong positive correlation in the two- to three-year time horizon between the other debt category and subsequent growth in credit card debt.

5 Conclusion

Using state-level data for the 2003–2019 period, we examine the medium-run relationship between student debt and consumption dynamics. Studying student debt separately from other types of household debt is important given its policy relevance, even if other types of household credit have more pronounced macroeconomic effects. Focusing on the educa-

tional attainment and debt repayment effects of changes in student debt, we find that an increase in the student debt-to-income ratio contributes to lower subsequent consumption growth. The estimated effects are larger when we use an instrumental variable approach to isolate the debt repayment channel. The combined responses of credit-constrained and unconstrained households generate significant effects at the aggregate level, which we are the first to document. This mechanism is consistent with the findings of prior studies suggestive of student borrowers being credit constrained after graduation (e.g. Rothstein and Rouse, 2011) and emphasizes the importance of binding credit constraints for consumption and borrowing dynamics (Mezza et al., 2021).

We also find suggestive evidence for the hypothesis that accumulating more student debt, holding educational attainment constant, leads borrowers to rely more on credit cards to finance their expenditures in the medium run. This is likely due to the response of unconstrained households, who increase their demand for borrowing when servicing their student loans. Credit-constrained households may not be able to tap into this type of borrowing.

This study is the first to combine the literature on the unintended consequences of student debt and the existing research on the macroeconomic effects of household debt. Our findings have several policy implications. Given the negative medium-run link between student debt and consumption growth, some level of student debt forgiveness, especially for borrowers who are likely to be credit-constrained, may prevent consumption dynamics from being affected through the debt repayment channel. As a recent example of such policy, the Department of Education announced the cancellation of debt held by students who attended but did not complete a degree from schools in a large for-profit chain (Marnin, 2021). In the same vein, income-driven repayment plans for student loans (such as the Income-Based Repayment and Pay As You Earn plans for federal loans) may help borrowers to maintain smoother

consumption patterns while paying off student debt and prevent pronounced declines in aggregate consumption. Our findings suggest that the pause in student loan payments initiated in March 2020 under the CARES Act also had positive macroeconomic effects.

Finally, it is important to emphasize that providing access to federal student loans allows students to attain higher education levels and increases their potential future income. While these benefits are not evenly distributed among borrowers due to factors such as non-completion of schooling or heterogeneity in the returns to different college majors, our results should not be interpreted as reason to lower access to student loans. Policymakers should focus on policies that would mitigate the negative macroeconomic consequences while maintaining the human capital benefits of the student loan program.

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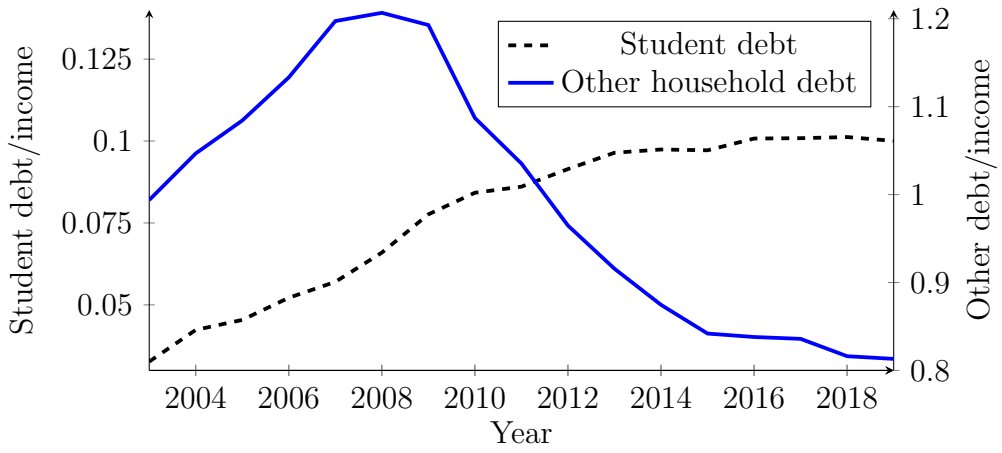
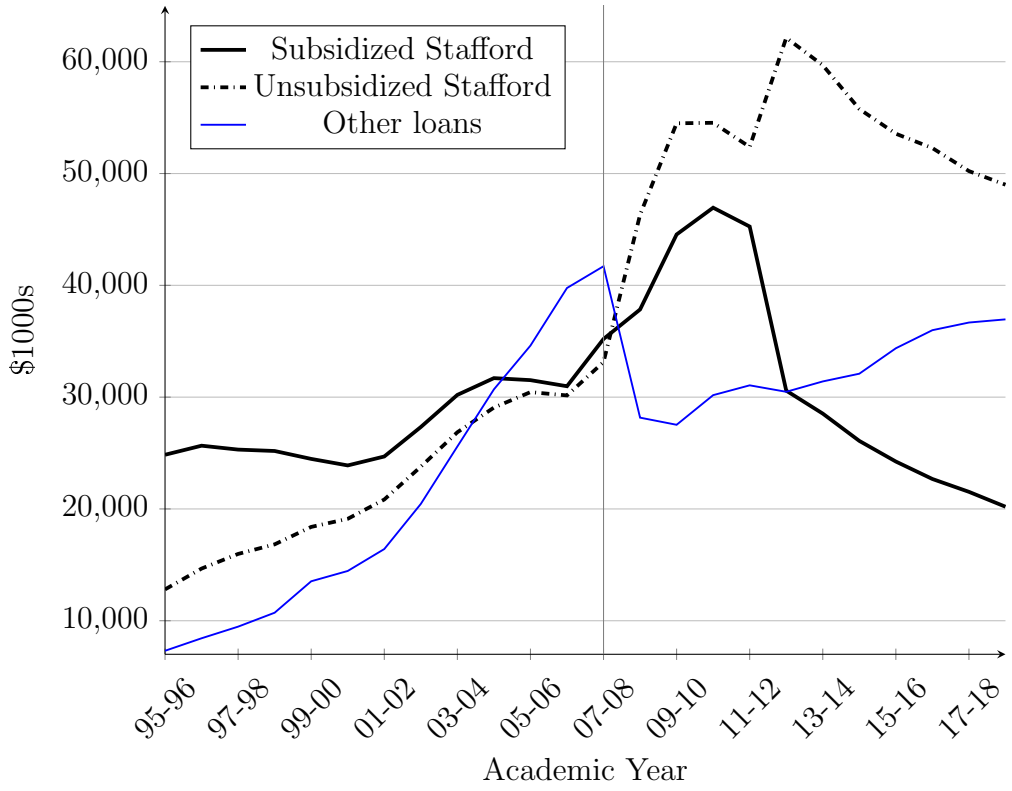
Figure 1: State-Level Student Debt and Other Household Debt As Fractions of Income



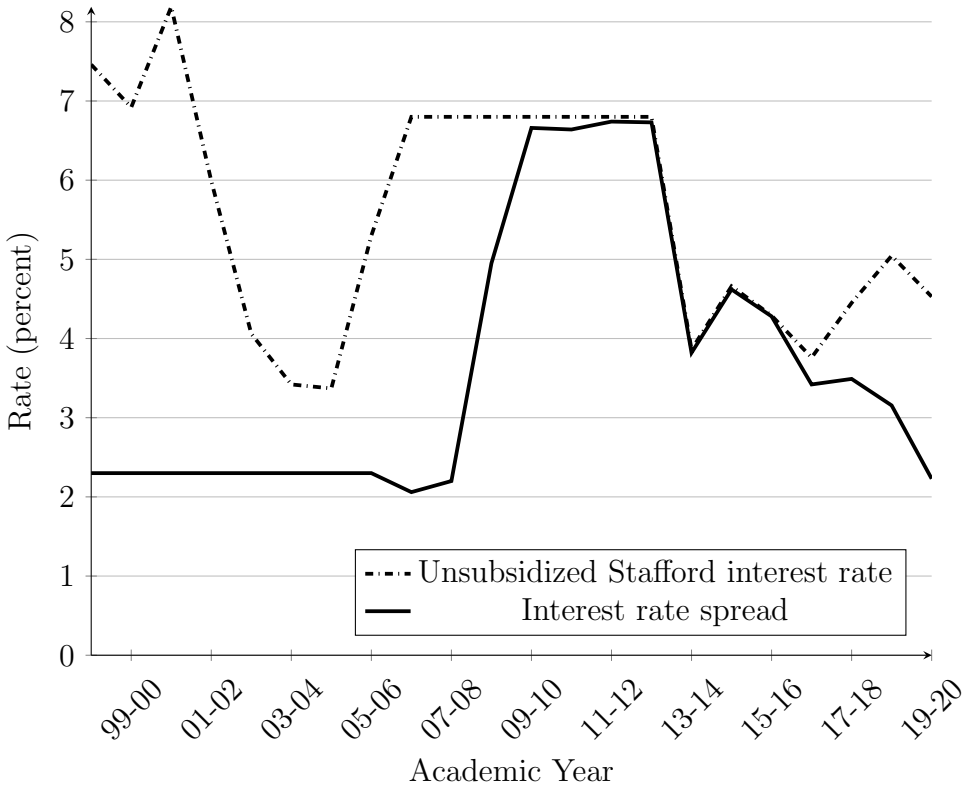
Source: Authors' calculations based on data from the Federal Reserve Bank of New York Consumer Credit Panel.

Figure 2: Annual Student Loan Disbursements



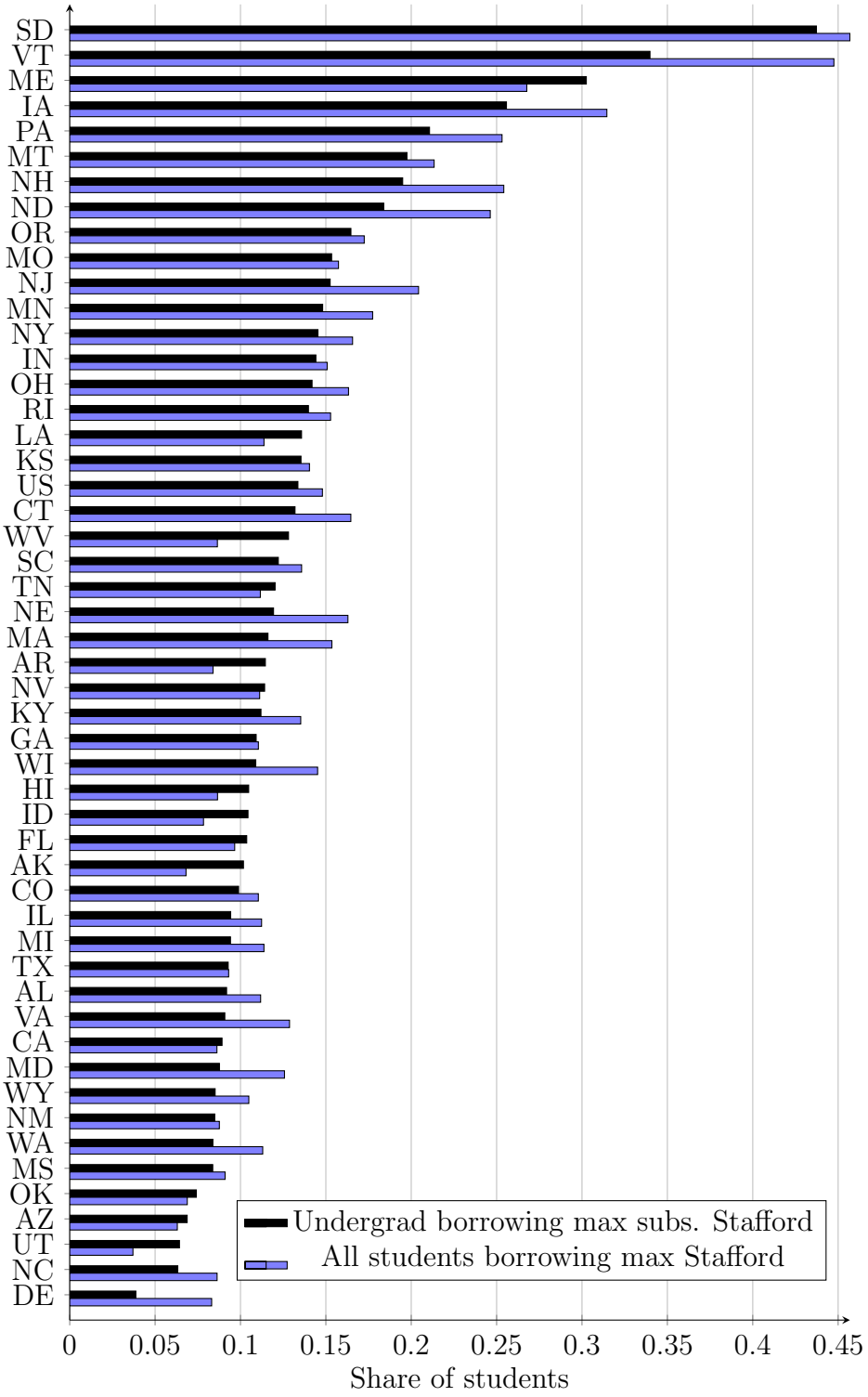
Source: Baum et al. (2019). Other loans include Perkins, parent and grad PLUS, and nonfederal loans. The vertical line shows the first year when the Higher Education Reconciliation Act of 2005 was in effect. All amounts are in 2018 dollars.

Figure 3: Unsubsidized Stafford Loan Rates and Spread



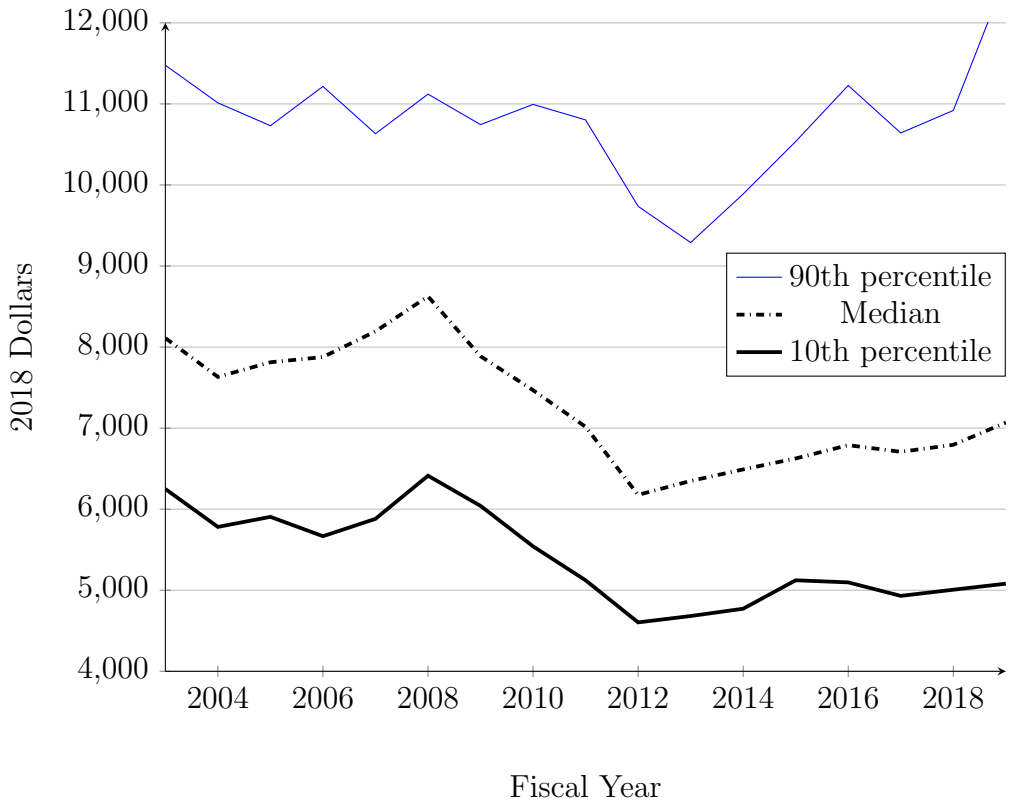
Stafford interest rates are for undergraduate students. The spread is calculated as the difference between the unsubsidized Stafford interest rate and the the 91-day Treasury Bill rate.

Figure 4: Exposure Levels by State



The shares of undergraduate students borrowing the maximum subsidized Stafford loan amount and share of undergraduate and graduate students borrowing the maximum total Stafford loan amount refer to the 1999–2000 academic year. Source: National Center for Education Statistics, NPSAS, 1999–2000 wave.

Figure 5: Distribution of Educational Appropriations per Full-Time Equivalent Student



Source: Authors' calculations based on data from the State Higher Education Executive Officers Association, State Higher Education Finance report.

Table 1: Changes in Stafford Loan Limits and Interest Rates

Legislation and Year Enacted	Provisions
A. Loan Limits	
Higher Education Reconciliation Act of 2005; 2007–2008 AY	Increased annual subsidized Stafford loan limits from \$2,625 to \$3,500 for freshmen and from \$3,500 to \$4,500 for sophomores; increased annual unsubsidized Stafford loan limits from \$10,000 to \$12,000 for graduate students; did not increase aggregate limits.
Ensuring Continued Access to Student Loans Act; 2008–2009 AY	Increased annual unsubsidized Stafford loan limits from \$4,000 to \$6,000 for freshmen and sophomores and from \$5,000 to \$7,000 for juniors and seniors who are independent or whose parents were denied a PLUS loan; increased the annual unsubsidized Stafford limit from \$0 to \$2,000 for dependent undergraduates whose parents were not denied a PLUS loan; increased aggregate limits for unsubsidized Stafford loans by \$8,000 for dependent undergraduate students whose parents were not denied a PLUS loan and by \$11,500 for independent undergraduate students and dependent undergraduate students whose parents were denied a PLUS loan.
Budget Control Act of 2011; 2012–2013 AY	Eliminated subsidized Stafford loans for graduate and professional students without changing total Stafford loan limits.
B. Interest Rates	
Prior to 2006-2007 AY	Variable interest rate that changes each year for the duration of the loan; interest rate equals 91-day Treasury Bill rate plus 2.3 percentage points.
Public Law 107-139; 2006–2007 AY	Interest rate of 6.8% for all subsidized and unsubsidized Stafford loans that remains fixed for the duration of the loan.
College Cost Reduction and Access Act of 2007; 2008–2009 AY	Lowered rates for subsidized Stafford loans; unsubsidized Stafford rates remained unchanged.
Bipartisan Student Loan Certainty Act of 2013; 2013–2014 AY	Subsidized and unsubsidized Stafford rate for undergraduate students set to 10-year Treasury Bill rate plus 2.05 percentage points.

AY stands for "academic year."

Table 2: Correlations between the Exposure Measures and Other State-Level Variables

Dep. variable:	% undergraduates borrowing max subsidized Stafford				% of all students borrowing max total Stafford			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Tuition at public 4-years ($1000s)	0.016***				0.031***			
	(0.006)				(0.006)			
Ln(appropriations per FTE)	-0.054**				-0.043*			
	(0.023)				(0.025)			
Public as share of total enrollment	-0.141**				-0.132**			
	(0.054)				(0.055)			
$\Delta_1 Unemployment_t$		-2.322	-0.604	1.489		-1.565	-1.398	2.475
		(1.808)	(1.271)	(2.021)		(2.322)	(1.954)	(2.885)
$\Delta_1 \ln Consumption_t$		-0.931	0.360	-0.418		-0.360	0.498	-0.366
		(0.784)	(0.954)	(0.753)		(0.999)	(1.288)	(1.170)
Year	2000	2000	2007	2016	2000	2000	2007	2016
Adjusted R-squared	0.368	0.002	-0.037	-0.016	0.532	-0.034	-0.030	-0.008

* p<0.10, ** p<0.05, *** p<0.01. Tuition and enrollment data are for the 1999–2000 academic year. Educational appropriations are for the 2000 fiscal year. Changes consumption and unemployment are measured between the indicated year and the year prior to that. Population sizes are used as estimation weights. All dollar amounts are adjusted for inflation. The reported errors are heteroskedasticity-robust. N = 50.

Table 3: Correlation between Changes in Consumption and Appropriations

Dep. variable:	$\Delta_3 \ln C_{t+3}$		
	(1)	(2)	(3)
$(\Delta Appropr_{t-1})/Appropr_{t-4}$	0.014	0.016	0.012
	(0.016)	(0.017)	(0.012)
Additional controls	None	Education	Full set
Adjusted R-squared	0.779	0.785	0.846

* p<0.10, ** p<0.05, *** p<0.01. All regressions include year and state fixed effects. Education controls include lagged changes for the state population share with college degree, state population share with some college, and the number of individuals in the state enrolled in college. The full set of controls includes the education measures, the lagged change in the state unemployment rate, lagged changes in the different household debt categories, and lagged consumption growth ($\Delta_3 C_{t-1}$). Population sizes are used as estimation weights. The reported standard errors are clustered at the state level. Population sizes are used as estimation weights. The reported errors are clustered at the state level. N = 500.

Table 4: Relationship between Student Debt and Consumption

Dependent variable:	$\Delta_\tau \ln Consumption_{t+\tau}$			
	$\tau = 1$	$\tau = 2$	$\tau = 3$	$\tau = 4$
	(1)	(2)	(3)	(4)
$\Delta_\tau(StudentDebt/Income)_{t-1}$	0.495***	0.027	-0.674**	-0.701**
	(0.187)	(0.211)	(0.303)	(0.308)
Controls for other types of household debt:				
$\Delta_\tau(MortgageDebt/Income)_{t-1}$	-0.030**	-0.033	-0.017	-0.034*
	(0.012)	(0.023)	(0.016)	(0.018)
$\Delta_\tau(CardDebt/Income)_{t-1}$	-0.229	0.408**	0.255	0.101
	(0.259)	(0.205)	(0.331)	(0.326)
$\Delta_\tau(AutoDebt/Income)_{t-1}$	0.150	0.122	0.309*	0.585***
	(0.186)	(0.188)	(0.171)	(0.178)
$\Delta_\tau(OtherDebt/Income)_{t-1}$	-0.063	-0.296***	-0.390***	-0.189
	(0.061)	(0.071)	(0.113)	(0.141)
Adjusted R-squared	0.802	0.852	0.846	0.815
N	700	600	500	400

* p<0.10, ** p<0.05, *** p<0.01. $\Delta_\tau z_s$ stands for the change in the variable z from year $s-\tau$ to s. The models include state and year fixed effects, lagged consumption growth ($\Delta_\tau C_{t-1}$), and controls for lagged changes in the state unemployment rate, the state population share with college degree, state population share with some college, and the number of individuals in the state enrolled in college. Population sizes are used as estimation weights. The reported standard errors are clustered at the state level.

Table 5: Effects of Student Debt on Consumption: Instrumental Variable Results

Dependent variable:	$\Delta_\tau \ln Consumption_{t+\tau}$					
	1st stage	TSLS	LIML	1st stage	TSLS	LIML
	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta_3(StudentDebt/Income)_{t-1}$		-1.579**	-1.595**		-1.476**	-1.487**
		(0.712)	(0.723)		(0.712)	(0.720)
Controls for other types of household debt:						
$\Delta_3(MortgageDebt/Income)_{t-1}$	0.003	-0.017	-0.017	0.001	-0.040**	-0.040**
	(0.006)	(0.016)	(0.016)	(0.005)	(0.016)	(0.016)
$\Delta_3(CardDebt/Income)_{t-1}$	0.170***	0.396	0.398	0.195***	0.776***	0.778***
	(0.059)	(0.359)	(0.360)	(0.050)	(0.268)	(0.268)
$\Delta_3(AutoDebt/Income)_{t-1}$	0.134**	0.363**	0.364**	0.132**	0.303	0.303
	(0.054)	(0.162)	(0.162)	(0.052)	(0.219)	(0.219)
$\Delta_3(OtherDebt/Income)_{t-1}$	-0.084***	-0.459***	-0.460***	-0.082***	-0.414***	-0.415***
	(0.024)	(0.125)	(0.126)	(0.024)	(0.126)	(0.126)
$\Delta_3 \ln(Consumption)_{t-1}$	-0.016	-0.262***	-0.262***			
	(0.018)	(0.097)	(0.097)			
$\Delta_3 HERA_{t-1} \times ExposureSubs$	0.037***			0.036***		
	(0.008)			(0.008)		
$\Delta_3 Spread_{t-1} \times ExposureAll$	-0.557***			-0.574***		
	(0.131)			(0.123)		
$(\Delta_3 Appropr_{t-1})/Appropr_{t-4}$	-0.009***			-0.009***		
	(0.002)			(0.002)		
F stat of excluded instruments	20.806			20.983		
Hansen J statistic		0.550	0.551		0.336	0.336
P value of J statistic		0.760	0.759		0.846	0.845
Adjusted R-squared		0.837	0.837		0.831	0.830

* p<0.10, ** p<0.05, *** p<0.01. $\Delta_\tau z_s$ stands for the change in the variable z from year $s-\tau$ to s. *HERA* stands for the years when the Higher Education Reconciliation Act of 2005 was in effect. *Spread* is the difference between the interest rate for unsubsidized Stafford loans and the 91-day T-bill rate. *ExposureSubs* is the percent of undergraduate students borrowing the maximum subsidized Stafford in the 1999–2000 academic year. *ExposureAll* is the percent of all students borrowing the maximum Stafford loan amount in 1999-2000. The models include state and year fixed effects and controls for lagged changes in the state unemployment rate, the state population share with college degree, state population share with some college, and the number of individuals in the state enrolled in college. Population sizes are used as estimation weights. The reported standard errors are clustered at the state level. N = 500.

Table 6: Relationship between Student Debt and Credit Card Debt

Dependent variable:	$\Delta_\tau(CardDebt/Income)_{t+\tau}$			
	$\tau = 1$	$\tau = 2$	$\tau = 3$	$\tau = 4$
	(1)	(2)	(3)	(4)
$\Delta_\tau(StudentDebt/Income)_{t-1}$	-0.172***	-0.108	-0.040	0.112*
	(0.033)	(0.066)	(0.049)	(0.062)
Controls for other types of household debt:				
$\Delta_\tau(MortgageDebt/Income)_{t-1}$	0.046***	0.014**	-0.003	-0.002
	(0.006)	(0.006)	(0.005)	-0.008
$\Delta_\tau(AutoDebt/Income)_{t-1}$	-0.008	0.124**	0.009	-0.175**
	(0.059)	(0.054)	(0.043)	-0.077
$\Delta_\tau(OtherDebt/Income)_{t-1}$	-0.019	0.111***	0.063***	0.029
	(0.018)	(0.025)	(0.018)	-0.026
Adjusted R-squared	0.823	0.870	0.902	0.943
N	700	600	500	400

* p<0.10, ** p<0.05, *** p<0.01. $\Delta_\tau z_s$ stands for the change in the variable z from year $s-\tau$ to s. The models include state and year fixed effects, lagged credit card debt growth ($\Delta_\tau CardDebt/Income_{t-1}$), and controls for lagged changes in the state unemployment rate, the state population share with college degree, state population share with some college, and the number of individuals in the state enrolled in college. Population sizes are used as estimation weights. The reported standard errors are clustered at the state level.

Table 7: Effects of Student Debt on Credit Card Debt: Instrumental Variable Results

Dependent variable:	$\Delta_3(CardDebt/Income)_{t+3}$					
	1st stage	TSLS	LIML	1st stage	TSLS	LIML
	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta_3(StudentDebt/Income)_{t-1}$		0.320	0.407*		0.321	0.426*
		(0.202)	(0.244)		(0.207)	(0.253)
Controls for other types of household debt:						
$\Delta_3(MortgageDebt/Income)_{t-1}$	0.001	-0.002	-0.002	0.009*	-0.013***	-0.014***
	(0.005)	(0.006)	(0.006)	(0.005)	(0.005)	(0.005)
$\Delta_3(AutoDebt/Income)_{t-1}$	0.132**	-0.011	-0.016	0.145***	-0.036	-0.043
	(0.052)	(0.062)	(0.067)	(0.047)	(0.063)	(0.069)
$\Delta_3(OtherDebt/Income)_{t-1}$	-0.082***	0.090***	0.096***	-0.095***	0.105***	0.113***
	(0.024)	(0.020)	(0.023)	(0.024)	(0.024)	(0.027)
$\Delta_3(CardDebt/Income)_{t-1}$	0.195***	-0.274***	-0.290***			
	(0.050)	(0.071)	(0.078)			
$\Delta_3 HERA_{t-1} \times ExposureSubs$	0.036***			0.028***		
	(0.008)			(0.007)		
$\Delta_3 Spread_{t-1} \times ExposureAll$	-0.574***			-0.504***		
	(0.123)			(0.125)		
$(\Delta_3 Appropr_{t-1})/Appropr_{t-4}$	-0.009***			-0.010***		
	(0.002)			(0.003)		
F stat of excluded instruments	20.983			19.714		
Hansen J statistic		4.99	4.69		4.52	4.29
P value of J statistic		0.082	0.096		0.104	0.117
Adjusted R-squared		0.888	0.880		0.876	0.864

* p<0.10, ** p<0.05, *** p<0.01. $\Delta_\tau z_s$ stands for the change in the variable z from year $s-\tau$ to s. *HERA* stands for the years when the Higher Education Reconciliation Act of 2005 was in effect. *Spread* is the difference between the interest rate for unsubsidized Stafford loans and the 91-day T-bill rate. *ExposureSubs* is the percent of undergraduate students borrowing the maximum subsidized Stafford in the 1999–2000 academic year. *ExposureAll* is the percent of all students borrowing the maximum Stafford loan amount in 1999-2000. The models include state and year fixed effects and controls for lagged changes in the state unemployment rate, the state population share with college degree, state population share with some college, and the number of individuals in the state enrolled in college. Population sizes are used as estimation weights. The reported standard errors are clustered at the state level. N = 500.

Appendix

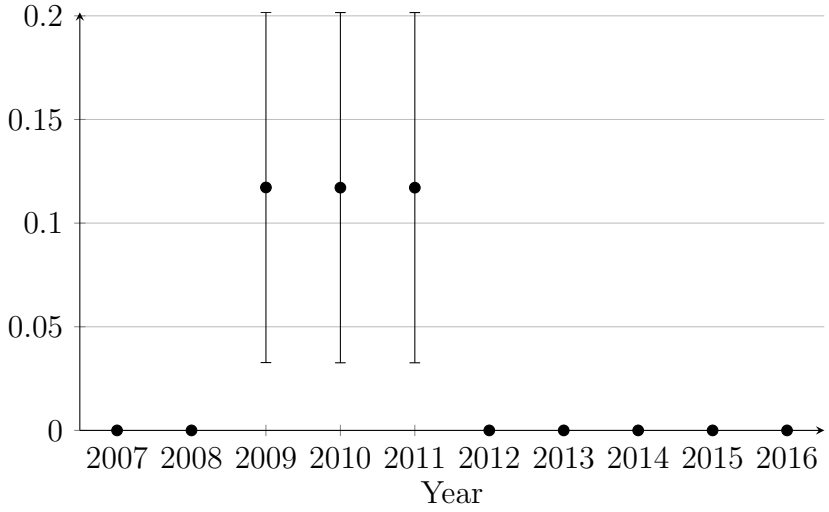
Table A1: Summary Statistics

Level of 2001–2002 appropriations:	Low	Medium	High
$\ln(Consumption)_t$	10.47	10.56	10.62
	(0.136)	(0.107)	(0.145)
$\Delta_3 \ln(Consumption)_{t+3}$	0.027	0.029	0.031
	(0.033)	(0.032)	(0.040)
$CardDebt/Income_t$	0.073	0.074	0.072
	(0.016)	(0.015)	(0.014)
$\Delta_3(CardDebt/Income)_{t+3}$	-0.007	-0.007	-0.006
	(0.009)	(0.010)	(0.009)
$StudentDebt/Income_t$	0.087	0.080	0.072
	(0.029)	(0.025)	(0.028)
$\Delta_3(StudentDebt/Income)_{t-1}$	0.016	0.014	0.013
	(0.010)	(0.009)	(0.009)
$MortgageDebt/Income_t$	0.684	0.675	0.916
	(0.221)	(0.194)	(0.281)
$\Delta_3(MortgageDebt/Income)_{t-1}$	-0.024	-0.028	-0.049
	(0.091)	(0.121)	(0.182)
$AutoDebt/Income_t$	0.093	0.088	0.077
	(0.015)	(0.022)	(0.017)
$\Delta_3(AutoDebt/Income)_{t-1}$	0.001	-0.000	-0.002
	(0.010)	(0.009)	(0.009)
$OtherDebt/Income_t$	0.082	0.074	0.087
	(0.021)	(0.024)	(0.028)
$\Delta_3(OtherDebt/Income)_{t-1}$	-0.008	-0.006	-0.009
	(0.014)	(0.015)	(0.021)
$\%CollegeGrad_t$	0.271	0.292	0.325
	(0.059)	(0.042)	(0.051)
$\Delta_3\%CollegeGrad_{t-1}$	0.010	0.011	0.012
	(0.010)	(0.008)	(0.008)
$\%SomeCollege_t$	0.317	0.309	0.295
	(0.027)	(0.032)	(0.028)
$\Delta_3\%SomeCollege_{t-1}$	0.004	0.002	0.001
	(0.014)	(0.011)	(0.011)
$Public4YearEnrollment_t$	124,030	309,370	352,175
	(61,969)	(201,123)	(239,887)
$(\Delta_3 Public4YearEnrollment_{t-1})/Public4YearEnrollment_{t-4}$	0.050	0.083	0.067
	(0.048)	(0.122)	(0.090)
$UnemploymentRate_t$	0.060	0.058	0.066
	(0.022)	(0.020)	(0.024)
$\Delta_3 UnemploymentRate_{t-1}$	-0.0004	0.0002	0.0002
	(0.026)	(0.024)	(0.029)
% Undergraduates Borrowing Max Subsidized Stafford in '99–'00	0.137	0.123	0.100
	(0.061)	(0.044)	(0.022)
% of All Students Borrowing Max Stafford in '99–'00	0.147	0.136	0.114
	(0.074)	(0.055)	(0.037)
$AppropriationsPerFTE_t$	5946	7313	9630
	(1206)	(1565)	(1913)
$(\Delta_3 AppropriationsPerFTE_{t-1})/AppropriationsPerFTE_{t-4}$	-0.033	-0.042	-0.014
	(0.162)	(0.140)	(0.145)
Number of states	13	24	13

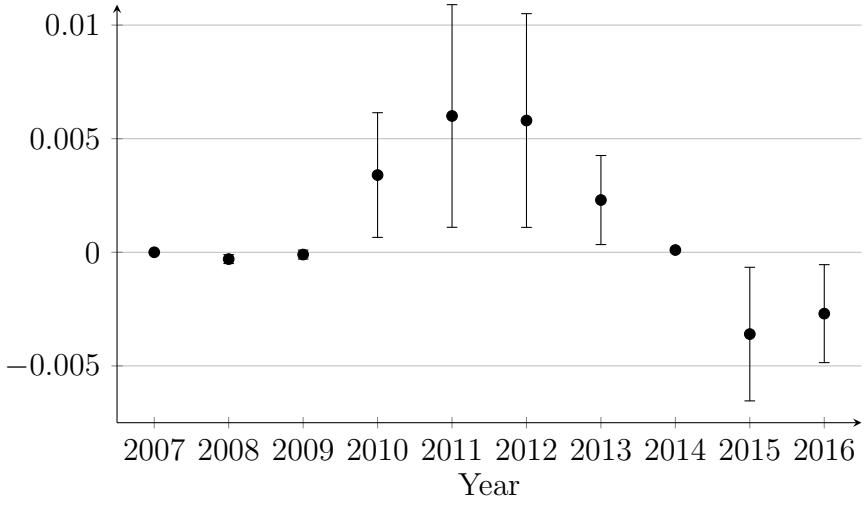
State-level data for 2003–2019. $\Delta_3 z_t$ stands for the change in the variable z from year $t-3$ to t. Population sizes are used as estimation weights. Standard deviations are shown in parentheses.

Figure A1: Distribution of the Instruments over Time

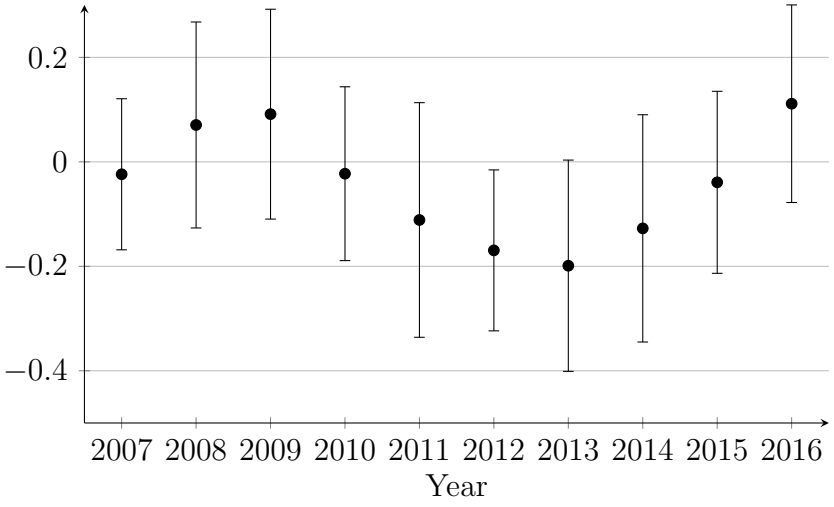
(a) $\Delta_3 HERA_{t-1} \times ExposureSubs$



(b) $\Delta_3 Spread_{t-1} \times ExposureAll$

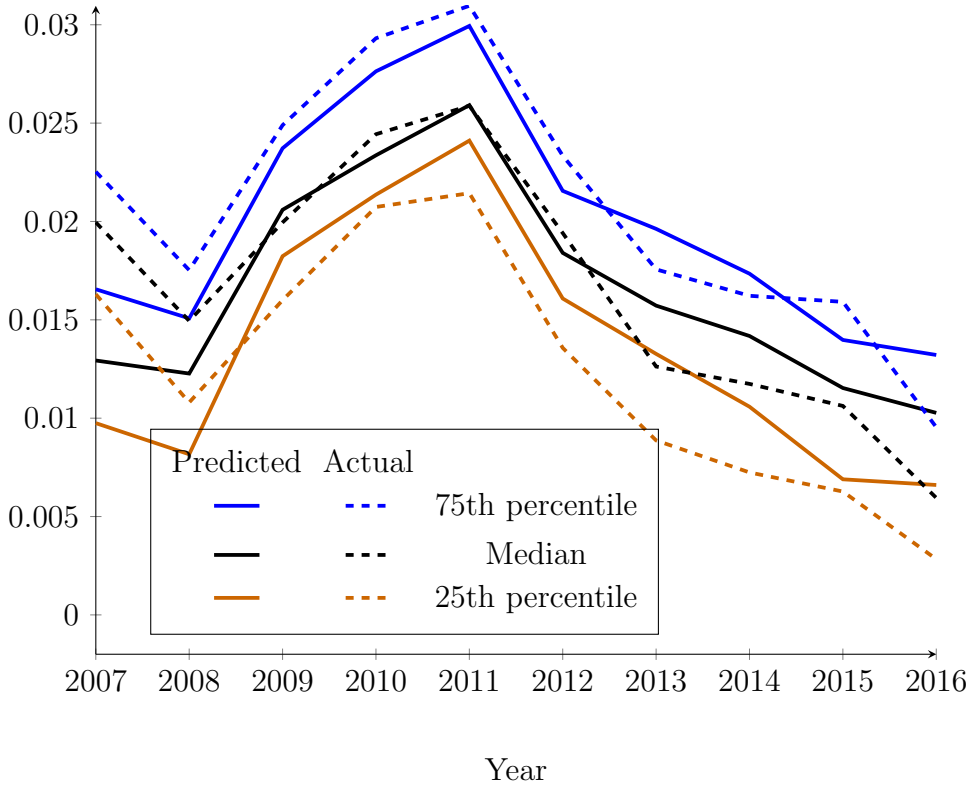


(c) $(\Delta_3 Appropr_{t-1})/Appropr_{t-4}$



Means and 95% confidence intervals. The calculations use population sizes as weights.

Figure A2: Distribution of Predicted and Actual Values of $\Delta_3(StudentDebt/Income)_{t-1}$



Predicted values are generated from a linear model that includes only the three instruments and state fixed effects. Population sizes are used as weights.